



Original Article

An Investigation of Health and Safety Measures in a Hydroelectric Power Plant

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ABSTRACT

Background: Occupational risk management is known as a catalyst in generating superior returns for all stakeholders on a sustainable basis. A number of companies in Ghana implemented health and safety measures adopted from international companies to ensure the safety of their employees. However, there exist great threats to employees' safety in these companies. The purpose of this paper is to investigate the level of compliance of Occupational Health and Safety management systems and standards set by international and local legislation in power producing companies in Ghana.

Methods: The methodology is conducted by administering questionnaires and in-depth interviews as measuring instruments. A random sampling technique was applied to 60 respondents; only 50 respondents returned their responses. The questionnaire was developed from a literature review and contained questions and items relevant to the initial research problem. A factor analysis was also carried out to investigate the influence of some variables on safety in general.

Results: Results showed that the significant factors that influence the safety of employees at the hydroelectric power plant stations are: lack of training and supervision, non-observance of safe work procedures, lack of management commitment, and lack of periodical check on machine operations. The study pointed out the safety loopholes and therefore helped improve the health and safety measures of employees in the selected company by providing effective recommendations.

Conclusion: The implementation of the proposed recommendations in this paper, would lead to the prevention of work-related injuries and illnesses of employees as well as property damage and incidents in hydroelectric power plants. The recommendations may equally be considered as benchmark for the Safety and Health Management System with international standards.

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1. Introduction

Health and safety at the workplace is paramount for the well-being of the workers and neglecting these can result in several unfortunate losses. Studies on occupational health and safety management have tended to cluster in certain areas during historical periods of time, focusing on policy and practice, individual characteristics and social relationships, events and incidents of injuries or accidents, management control, and industrial relations [1]. Early research by psychologists and sociologists examined individual dispositions and social causes utilizing disciplinary frameworks in developing concepts and theoretical insights into

occupational health and safety [2]. These findings were further enhanced by the results of workplace surveys by industrial relations specialists that drew attention to the importance of legislation and innovative nonregulatory as well as regulatory strategies [3]. Since 1950, the International Labor Organization and the World Health Organization have shared a common definition of occupational health that was adopted in 1950 and later in 1995. The definition reads as follow:

“Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departments from health caused by their

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working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job.”

Furthermore, it was argued that the subject of safety and health in the workplace covers a wide spectrum of issues. Among them are issues related to working with hazardous chemicals and minerals as identified by Hirtenlehner [4]: (1) exposure to contagious diseases and passive smoking [5]; (2) psychological safety such as stress, fears, and attitudes [6]; (3) psychosocial safety such as indifference, xenophobia, homophobia, and lesbophobia [7]; (4) criminal and sexual harassment in the workplace [8]; (5) working within harmful workplace emissions [9]; (6) manufactured and manufacturing of harmful substances and innovations [10]; (7) harmful infrastructural constructions such as unsafe stairways, unsafely built structures, and slippery floors [11]; and (8) terroristic intrusions and massacres in the workplace and safety precautions, safety communication measures, and personal protection equipment [12–14].

In recent times, occupational health and safety in power plants has seen a significant improvement due to increased oversight and government regulations in safety. In South Africa, an occupational Health and Safety Act Number 85 enacted in 1993, states that the general duties of employers to their employees is to make sure that they provide and maintain as far as reasonably practicable, a working environment that is safe and without risk to the health of any employee. This means making sure those workers and others are protected from anything that may cause harm, and effectively controlling any risk to injury or health that could arise in the workplace. Despite the safety act mentioned above, there are unfortunately, an estimated 2 million men and women who die every year according to the International Labor Organization and this is as a result of occupational accidents and work-related diseases. This can be attributed to the noncompliance of most power industries to the regulations.

In 2009, an accident occurred at Sayano-Shushenskaya near Sayanogorsh in Khakassia, Russia where the failure of a hydroelectric power station caused death to 75 people [15]. The accident was due to a violent breakdown of turbines. The turbine hall and engine room were flooded, the ceiling of the turbine hall collapsed, and nine out of 10 turbines were damaged or destroyed. The entire plant output, totaling 6,400 MW, and a significant portion of the supply to the local electric grid was lost, leading to widespread power failure in the local area, and forcing major users such as aluminum smelters to switch to diesel generators. The Sayano-Shushenskaya dam failure was not the only hydroelectric dam failure which has caused loss of life and major damage in the surrounding area. Accidents in this sector are rare but the consequences are usually very fatal. Planners need to take a lot of geological and environmental issues into account when building new hydroelectric plants.

In addition, the Taum Sauk Hydroelectric Power Station, Missouri, USA, also witnessed a failure resulting into five people being injured and permanent damage to the surrounding landscape followed by a period of no power generation that lasted about 5 years. The cause of this failure can be attributed to technical faults that were neglected or mismanaged. It was observed that the gauging system was faulty but the plant was still run. The incident led to the draining of over a billion gallons of water (4 million m³) in less than 1 hour [16,17].

Moreover, in June 2013, the failure of the Dhauliganga hydroelectric station (280 MW) in India caused an unprecedented flood leading to the complete submergence of a power house [18]. Some

more adverse effects were massive debris accumulation, electrical equipment replacement, and loss of total generation capacity for more than 6 months.

Furthermore, Hirtenlehner [4] has supported the fact that construction of large hydropower plants involves potentially high risks for the health and lives of persons as well as for the environment. Therefore a particularly high level of safety is required for such plants. Although most regulations in this sector are provided by international organizations such as International Organization for Standardization (ISO) in the form of standards, many companies and countries, including Ghana, failed to live up to the expectation of those standards. This explains the motivation to measure the level of noncompliance to regulations by power plants in Ghana. A reputed power plant in Ghana will be adopted for this study. The ISO and Occupational Safety and Health (OSH) standards will be adopted to conduct a Health and Safety Audit in the selected power plant of Ghana to ascertain or to determine whether activities and related results conform to planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve the organization's policy and objectives. The concern of this paper is on existing great threats to employees' safety increasing the risk of occupational accidents and employee's exposure to hazards regarding hydroelectric power plant station operation. Furthermore this will help to measure the level of compliance of the power plant company to ISO regulations. Finally, this paper will also help to improve health and safety measures of employees at the hydroelectric power plant. The rest of the paper is organized as follows: Section 2 presents the materials and method (a quantitative method with administered questionnaires is first developed followed by a factor analysis). Section 3 presents the discussion of the results and the conclusion.

2. Material and methods

According to Antonsen [19] in 2009, safety climates are assessed/measured by conducting questionnaire surveys among a group of workers in an organization. In such surveys, workers are asked to complete a specific, standardized questionnaire, i.e., giving their perception/opinion (or the perception that is shared among the coworkers) on certain safety related dimensions. The resulting data of the survey are processed and analyzed, providing a snapshot of the present safety climate in an organization. Furthermore, Bennet [20] in 2002 argues that workers, unlike tools or objects of production, are living human beings that need to be involved in the improvement of working conditions and should participate at all levels, including international levels, on issues that affect their livelihoods. Workers' perspectives need to be considered in devising and carrying out health and safety measures at the workplace.

In this regard, both qualitative and quantitative research approaches have been adopted in this paper. A random sampling technique was applied on a population of 60 workers. Fifty respondents were selected from the hydroelectric power plant. This included four managers, 14 supervisors, eight safety officers, and 24 technician engineers of the hydroelectric power plant in Ghana. Questionnaires made of close-ended questions were distributed to the following departments: the Project and System Monitoring Department and the Power Generating Station Department (the power house). SPSS version 14.0 (SPSS Inc., Chicago, IL, USA) was used to perform the analysis and Microsoft Excel 2010 (Microsoft Corporation) was used to generate the charts to explain the results. A factor analysis was also conducted on the collected data in order to determine the most influential factor and recommend means of curbing their impacts.

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